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(54) Paper containing alkaline sizing agents with improved conversion capability

Alkalische Leimungsmittel enthaltendes Papier mit verbesserten Verarbeitungseigenschaften

Papier contenant des agents de collage alcalins et avec capacité de conversion améliorée

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Description

[0001] This invention relates to the use of alkaline fine paper sized with a 2-oxetanone sizing agent for high speed reprography or conversion into standard perforated continuous form paper, envelopes, adding machine paper or continuous forms bond paper.

[0002] The amount of fine paper produced under alkaline conditions has been increasing rapidly, encouraged by cost savings, the ability to use precipitated calcium carbonate (PCC), an increased demand for improved paper permanence and brightness, and an increased tendency to close the wet-end of the paper machine.

[0003] Current applications for fine paper require particular attention to sizing before conversion or end-use, such as high-speed photocopies, envelopes, forms bond including computer printer paper, and adding machine paper. The most common sizing agents for fine paper made under alkaline conditions are alkenyl succinic anhydride (ASA) and alkyl ketene dimer (AKD). Both types of sizing agents have a reactive functional group that covalently bonds to cellulose fiber and hydrophobic tails that are oriented away from the fiber. The nature and orientation of these hydrophobic tails cause the fiber to repel water.

[0004] Commercial AKD's, containing one β-lactone ring, are prepared by the dimerization of the alkyl ketenes made from two saturated, straight-chain fatty acid chlorides; the most widely used being prepared from palmitic and/or stearic acid. Other ketene dimers, such as the alkenyl based ketene dimer (Aquapel® 421 of Hercules Incorporated), have also been used commercially. Ketene multimers, containing more than one such β-lactone ring, have been described in Japanese Kokai 168992/89, the disclosure of which is incorporated herein by reference. ASA-based sizing agents may be prepared by the reaction of maleic anhydride with an olefin (C_{14}-C_{18}).

[0005] Although ASA and AKD sizing agents are commercially successful, they have disadvantages. Both types of sizing agents, particularly the AKD type, have been associated with handling problems in the typical high-speed conversion operations required for the current uses of fine paper made under alkaline conditions (referred to as alkaline fine paper). The problems include reduced operating speed in forms presses and other converting machines, double feeds or jams in high-speed copiers, and paper-welding and registration errors on printing and envelope-folding equipment that operates at high speeds.

[0006] These problems are not normally associated with fine paper produced under acid conditions (acid fine paper). The types of filler and filler addition levels used to make alkaline fine paper differ significantly from those used to make acid fine paper, and can cause differences in paper properties such as stiffness and coefficient of friction which affect paper handling. Alum addition levels in alkaline fine paper, which contribute to sheet conductivity and dissipation of static, also differ significantly from those used in acid fine paper. This is important because the electrical properties of paper affect its handling performance. Sodium chloride is often added to the surface of alkaline fine paper to improve its performance in end use.

[0007] The typical problems encountered with the conversion and end-use handling of alkaline fine paper involve:

1. Paper properties related to composition of the furnish;
2. Paper properties developed during paper formation; and
3. Problems related to sizing.

[0008] The paper properties affected by paper making under alkaline conditions that can affect converting and end-use performance include:

- Curl
- Variation In Coefficient Of Friction
- Moisture Content
- Moisture Profile
- Stiffness
- Dimensional Stability

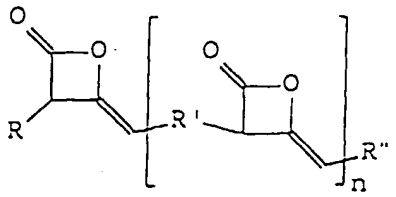
billowing, typically of the order of 20 to 80. Paper handling rates on other high-speed converting machinery, such as a Hamilton-Stevens continuous forms press or a Winkler & Dunnebier CH envelope folder, also provide numerical measures of convertiblity.

[0009] EP-A-0-629 741, published on 21 December 1991, discloses a process for making fine paper that is sized under alkaline conditions with a 2-oxetanone sizing agent. The 2-oxetanone sizing agent is formed from linear, saturated alkyl monocarboxylic such as stearic, myristic, palmitic or margaric acids. The paper can be in the form of continuous forms bond paper, adding machine paper and reprographic paper and can also be converted into envelopes.

[0010] There is a need for alkaline fine paper that provides improved handling performance in typical converting and reprographic operations. At the same time, the levels of sizing development need to be comparable to that obtained

with the current furnish levels of AKD or ASA for alkaline fine paper.

[0011] The present invention provides the use of alkaline fine paper sized with a 2-oxetanone sizing agent of formula (I) which is liquid at 25°C for high speed reprography or conversion into standard perforated continuous form paper, envelopes, adding machine paper or continuous forms bond paper;



(I)

wherein n is an integer of 0-6, R and R" are independently a straight or branched chain alkyl group having at least 6 carbon atoms or a straight or branched chain alkenyl group having at least 6 carbon atoms and R' is a straight chain alkyl group, provided that one or both of R and R" are alkenyl and/or branched alkyl.

[0012] Preferably, the 2-oxetanone sizing agent is a liquid at 20°C. (The references to "liquid" of course apply to the sizing agent per se and not to an emulsion or other combination). The paper according to the invention does not encounter significant machine-feed problems on high speed converting machines and reprographic operations. Such problems are defined as significant in any specific conversion or reprographic application if they cause misfeeds, poor registration, or jams to a commercially unacceptable degree as will be discussed below, or cause machine speed to be reduced.

[0013] The index n is either 0 (zero) or 1-6, preferably 0 to 3, and most preferably 0.

[0014] Preferably at least 25% by weight of the sizing agent consists of the 2-oxetanone structure in which at least one cf R and R" is not straight chain alkyl.

[0015] R and R" are substantially hydrophobic in nature and are acyclic. When n>0 the materials are termed 2-oxetanone multimers.

[0016] R' is preferably a C_6-C_{16} straight chain alkyl, most preferably a C_{8-12} straight chain alkyl.

[0017] Preferably, the alkaline fine paper is internally sized with the 2-oxetanone sizing agent.

[0018] Preferably the alkaline fine paper contains a water soluble inorganic salt of an alkali metal, preferably NaCl, as well as alum and precipitated calcium carbonate (PCC). However, the paper of this invention will often be made without NaCl.

[0019] The paper of this invention is generally sized at a size addition rate of at least 0.25 kg, preferably at least 0.75 kg and most preferably 1.1 kg per tonne or higher (at least 0.5, preferably at least 1.5, and most preferably at least 2.2 pounds/ton or higher). For instance, the alkaline fine paper may contain 1.1 to 4.0 kg/metric ton (2.2-8 pounds/ton) of sizing agent. It may be, for instance, continuous forms bond paper, adding machine paper, or envelope-making paper, as well as the converted products, such as copy paper and envelopes.

[0020] The 2-oxetanone-based sizing agent used in this invention has irregularities in the chemical structure of its pendant hydrophobic constituents. Preferably one or both R and R" is/are alkenyl. Alternatively, one or both R and R" is/are branched. (Conventional AKD'S are regular in that they have saturated straight-chain hydrocarbon chains).

[0021] Preferably the 2-oxetanone sizing agent is made from a fatty acid selected from the group consisting of oleic, linoleic, linolenic or palmitoleic fatty acid chlorides, or a mixture of them. More preferably, the 2-oxetanone sizing agent made from a fatty acid selected from the said group is at least 25% of the sizing agent, more preferably at least about 50% and most preferably at least about 70%. Also preferably each pendant hydrocarbon chain has 6 to 22 carbon atoms, most preferably 10 to 22 carbon atoms.

[0022] The 2-oxetanone sizing agent may also be formed from at least one dicarboxylic acid selected from sebacic acid and azelaic acid.

[0023] Preferably the paper according to the invention is capable of performing effectively in tests that measure its convertibility on state-of-the-art converting equipment and its performance on high speed end-use machinery. In particular, the paper according to the invention, that can be made into a roll of continuous forms bond paper having a basis weight of 48.8-97.6 g/m^2 (from about 30 to 60 lbs./3000 ft^2), more specifically 65.1-81.4 g/m^2 (about 40 to 50 lbs./3000 ft^2), and that is sized at an addition rate of at least about 1.1 kg/tonne (2.2 pounds/ton), is capable of running on the IBM Model 3800 high speed, continuous-forms laser printer without causing a rate of billowing in inches of increase per second x 10,000 greater than about 5.

[0024] Further, the preferred paper according to the invention, that can be made into sheets of 21.6 x 27.9 cm (8 1/2

x 11 inch) reprographic cut paper having a basis weight of about 56.4-90.2 g/m^2 (15-24 lbs./1300 ft^2) and is sized at an addition rate of at least about 1.1 kg per tonne (2.2 pounds/ton), is capable of running on a high speed laser-printer or copier without causing misfeeds or jams at a rate of 5 or less in 10,000. The preferred paper according to the invention, having a basis weight of about 56.4-90.2 g/m^2 (15-24 lbs./1300 ft^2), also can be converted to a standard perforated continuous form on the Hamilton-Stevens continuous form press at a press speed of at least about 9 m/sec. (1775 feet per minute).

[0025] The invention also comprises the process of converting the paper according to the invention to a standard perforated continuous form on a continuous forms press at a press speed of 6.6-10.2 m/sec. (from about 1300 to 2000 feet per minute).

[0026] A further process according to the invention comprises running 21.6 x 27.9 cm (8 1/2 x 11 inch) reprographic cut paper, having a basis weight of about 56.4-90.2 kg/m^2 (15-24 lbs./1300 ft^2), on a high speed, continuous laser printer or copier without causing misfeeds or jams at a rate of 5 or more in 10,000, preferably without causing misfeeds or jams at a rate of 1 or more in 10,000. By comparison, paper sized with standard AKD had a much higher rate of double feeds on the IBM 3825 high speed copier (14 double feeds in 14,250 sheets). In conventional copy-machine operation, 10 double feeds in 10,000 sheets is unacceptable. A machine manufacturer considers 1 double feed in 10,000 sheets to be unacceptable.

[0027] Another process according to the invention comprises converting the paper according to the invention into at least about 900 envelopes per minute, preferably at least about 1000 per minute.

[0028] Alkaline sizing agents, that give levels of sizing comparable to those obtained with current AKD and ASA sizing technology, and improved handling performance in typical end-use and converting operations, have a reactive 2-oxetanone group and pendant hydrophobic hydrocarbon tails. In that respect, they resemble traditional AKD-based sizing agents, but unlike the saturated straight chains in the fatty acids used to prepare conventional solid alkyl ketene dimer based sizing agents, the hydrocarbon chain in one or both of the fatty acid chlorides used to prepare this class of sizing agents contain irregularities in the chemical structure of the pendant hydrocarbon chains, such as carbon-to-carbon double bonds and chain branching. Due to the irregularities in the pendant hydrocarbon chains, these sizing agents are liquid, at or near room temperature.

[0029] Examples of this class of sizing agents are 2-oxetanone based materials prepared from oleic acid, and 2-oxetanone based materials prepared from either Pamak-1 or Pamolyn 380 liquid fatty acid (fatty acid mixtures available from Hercules Incorporated and consisting primarily of oleic and linoleic acid. Other examples of fatty acids that may be used are the following unsaturated fatty acids: dodecenoic, tetradecenoic (myristoleic), hexadecenoic (palmitoleic), octadecadienoic (linolelaidic), octadecatrienoic (linolenic), eicosenoic (gadoleic), eicosatetraenoic (arachidonic), docosenoic (erucic), docosenoic (brassidic), and docosapentaenoic (clupanodonic) acids.

[0030] 2-oxetanone multimers formed from mixtures of these fatty acids and a dicarboxylic acid are also examples, including: 2-oxetanone multimers prepared from a 2.5:1 mixture of oleic acid and sebacic acid, and 2-oxetanone multimers prepared from a 2.5:1 mixture of Pamak-1 fatty acid and azelaic acid. Preferred examples are 2-oxetanone multimers with fatty acid to diacid ratios ranging from 1:1 to 3.5:1. These reactive sizing agents are disclosed as being prepared using methods known from Japanese Kokai 168992/89, the disclosure of which is incorporated herein by reference. In the first step, acid chlorides from a mixture of fatty acid and dicarboxylic acid are formed, using phosphorous trichloride or another conventional chlorination agent. The acid chlorides are then dehydrochlorinated in the presence of triethylamine or another suitable base, to form the multimer mixture. Stable emulsions of these sizing agents can be prepared in the same way as standard AKD emulsions.

[0031] One novel sizing agent for use in this invention is a 2-oxetanone sizing agent that is made from linoleic acid or a mixture of fatty acids containing at least 25%, preferably at least 35%, linoleic acid.

[0032] A further sizing agent for use in this invention is one formed from a mixture of fatty acids containing at least 25 wt.% oleic acid.

[0033] Preferred sizing agents are made from a mixture comprising 25-75%, more preferably 35-65% linoleic acid and 75-25%, more preferably 65-35% oleic acid, such as Pamak-1.

[0034] Paper for evaluation on the IBM 3800 was prepared on the pilot paper machine at Western Michigan University.

[0035] To make a typical forms bond paper-making stock, the pulp furnish (three parts Southern hardwood kraft pulp and one part Southern softwood kraft pulp) was refined to 425 ml Canadian Standard Freeness (C.S.F.) using a double disk refiner. Prior to the addition of the filler to the pulp furnish (10% medium particle-size precipitated calcium carbonate), the pH (7.8-8.0), alkalinity (150-200 p.p.m.), and hardness (100 p.p.m.) of the paper making stock were adjusted using the appropriate amounts of $NaHCO_3$, NaOH, and $CaCl_2$.

[0036] The 2-oxetanone sizing agents, including the multimers, were prepared by methods used conventionally to prepare commercial AKD's; i.e, acid chlorides from a mixture of fatty acid and dicarboxylic acid are formed, using a conventional chlorination agent, and the acid chlorides are dehydrochlorinated in the presence of a suitable base. The 2-oxetanone sizing agent emulsions, including the multimer emulsions, were prepared according to the disclosure of U.S. Patent 4,317,756, which is incorporated herein by reference, with particular reference to Example 5 of the patent.

Wet-end additions of sizing agent, quaternary-amine-substituted cationic starch (0.75%), alum (0.2%), and retention aid (0.025%) were made. Stock temperature at the headbox and white water tray was controlled at 43°C (110 °F).

[0037] The wet presses were set at 2.8 kg/cm^2 (40 p.s.i. gauge). A dryer profile that gave 1-2% moisture at the size press and 4-6% moisture at the reel was used (0.39 m/sec) (77 f.p.m.)). Before the size press, the sizing level was measured on a sample of paper torn from the edge of the sheet, using the Hercules Size Test (HST). With Hercules Test Ink #2, the reflectance was 80%. Approximately 17.5 kg/tonne (35 lb/ton) of an oxidized corn starch and 0.5 kg/tonne (1 lb/ton) of NaCl were added at the size press (54°C (130 °F), pH 8). Calender pressure and reel moisture were adjusted to obtain a Sheffield smoothness of 150 flow units at the reel (Column #2, felt side up).

[0038] A 35 minute roll of paper from each paper making condition was collected and converted on a commercial forms press to two boxes of standard 21.6 x 27.9 cm (8½" x 11") forms. Samples were also collected before and after each 35 minute roll for natural aged size testing, basis weight (74.9 g/m^2 (46 lb/3000 ft^2)), and smoothness testing.

[0039] The converted paper was allowed to equilibrate in the printer room for at least one day prior to evaluation. Each box of paper allowed a 10-14 minute (1.1 m/sec (220 f.p.m.)) evaluation on the IBM 3800. All samples were tested in duplicate. A standard acid fine paper was run for at least two minutes between each evaluation to re-establish initial machine conditions.

[0040] The height of billowing in inches at the end of the run, and the rate at which billowing occurred (inches of increase in billowing per second) , were used to measure the effectiveness of each approach.

[0041] Preferably the use provided by the present invention provides paper in the form of a roll of continuous forms bond paper having a basis weight of 56.4-90.2 g/m^2 (about 15-24 lbs/1300 ft^2), and is run on a high speed, continuous-forms laser printer.

[0042] Preferably the use provided by the present invention provides paper in the form of 21.6 x 27.9 cm (8½ x 11 inch) reprographic cut paper, having a basis weight of about 56.4-90.2 g/m^2 (15-24 lbs./1300 ft^2), sized at an addition rate of at least about 1.1 kg/tonne (2.2 pounds/ton), and is run on a high speed, laser printer or copier.

[0043] Preferably the paper is converted to a standard perforated continuous form on a continuous forms press at a press speed of at least about 9.0 m/sec. (1775 feet per minute).

[0044] Preferably the use provided by the present invention provides paper that can be made into a roll of continuous forms bond paper having a basis weight of about 48.8-97.6 g/m^2 (30 to 60 lbs/3000 ft^2) and that is sized at an addition rate of at least about 1.1 kg/tonne (2.2 pounds/ton), and that is then capable of running on the IBM Model 3800 high speed, continuous forms laser printer without causing a rate of billowing in inches of increase per second x 10,000 greater than about 3, after 10 minutes of running time.

[0045] Preferably the use provided by the present invention provides paper that can be made into 21.6 x 27.9 cm (8½ x 11 inch) reprographic cut paper having a basis weight of about 56.4-90.2 kg/m^2 (15-24 lbs./1300 ft^2) and that is sized at an addition rate of at least about 1.1 kg/tonne (2.2 pounds/ton), that is then capable of running on the IBM Model 3825 high speed, laser printer or copier without causing misfeeds or jams at a rate of about 1 or less in 10,000.

[0046] Preferably the use provided by the present invention provides paper that can be made into a roll of continuous forms bond paper having a basis weight of about 56.4-90.2 kg/m^2 (15 to 24 lbs./1300 ft^2) and that is sized at an addition rate of at least about 1.1 kg/tonne (2.2 pounds/ton), and that is then capable of being converted to a standard perforated continuous form on a Hamilton-Stevens continuous forms press at a press speed of at least about 9.0 m/sec (1775 feet per minute).

[0047] Preferably the use provided by the present invention provides paper that can be made into a roll of envelope paper having a basis weight of about 56.4-90.2 kg/m^2 (15 to 24 lbs./1300 ft^2) and that is sized at an addition rate of at least about 1.1 kg/tonne (2 pounds/ton), and that is then capable of being converted into at least about 950 envelopes per minute on a Winkler & Dunnebier CH envelope folder.

[0048] Preferably the use provided by the present invention provides paper that has been processed in a photocopy machine at a rate of at least about 58 sheets per minute.

[0049] Preferably the use provided by the present invention provides reprographic grade, that is produced in a commercial paper machine at least about 16 m/sec. (3100 f.p.m.) at a basis weight of at least about 113 g/m^2 (30 lb/1300 ft^2).

[0050] Preferably the use provided by the present invention provides paper having a given basis weight and sized at a given level, and that is capable of running on a high speed, continuous-forms laser printer with a rate of billowing at least 10% less than that produced when running, on the same printer, a roll of continuous forms bond paper having the same basis weight and sized at the same level with an AKD size made from a mixture of stearic and palmitic acids, after 10 minutes of running time.

[0051] Preferably the use provided by the present invention provides paper having a given basis weight and sized at a given level, that is capable of running on a high speed IBM 3825 sheet-fed copier at a speed of about 58 sheets per minute with at least about 50% fewer double-feeds or jams than the number of double-feeds or jams caused when running, on the same copier, sheets of paper having the said basis weight and sized at the said level with an AKD size made from a mixture of stearic and palmitic acids.

[0052] Preferably the use provided by the present invention provides paper having a given basis weight and sized

at a given level, that is capable of being converted to a standard perforated continuous form on a continuous forms press at a press speed at least 3% higher than paper having the said basis weight and sized at the said level with an AKD size made from a mixture of stearic and palmitic acids.

[0053] Preferably the use provided by the present invention provides paper that can be made into a roll of envelope paper having a given basis weight and sized at a given level, that is capable of being converted into at least 3% more envelopes per minute on a Winkler & Dunnebier CH envelope folder than paper having the said basis weight and sized at the said level with an AKD size made from a mixture of stearic and palmitic acids can be converted on the same envelope folder.

Example 1

[0054] A number of sizing agents were tested for their effects on the IBM 3800 runnability of a difficult-to-convert grade of alkaline fine paper. The above Experimental Procedures were followed.

[0055] The rate of paper billowing on an IBM 3800 high speed printer was used to evaluate the converting performance of each sample of paper. A summary of the results of this testing is given in Table 1.

[0056] Several 2-oxetanone based alkaline sizing agents *are shown* that give a better balance of sizing and runnability on the IBM 3800 (for instance, less billowing at similar levels of sizing) than a standard AKD sizing agent made for comparative purposes. The standard AKD sizing agent was made from a mixture of stearic and palmitic acids. This is a standard sizing agent of the type that lacks any irregularities, such as double bonds or branching, in its pendant hydrocarbon chains. The best balance of sizing and handling performance was obtained with one of the following agents: a 2-oxetanone based sizing material made from a mixture of about 73% oleic acid, about 8% linoleic acid, and about 7% palmitoleic acid, the remainder being a mixture of saturated and unsaturated fatty acids, available from Henkel-Emery under the name Emersol NF (referred to herein for convenience along with similar sizes based on oleic acid as an oleic acid size).

[0057] Another 2-oxetanone size prepared from Pamolyn 380 fatty acid, consisting primarily of oleic and linoleic acid and available from Hercules Incorporated, and a 2-oxetanone sizing agent made from isostearic acid. All these sizing agents were liquids at 25°C, and in particular, at equal sizing levels, gave better converting performance on the IBM 3800 than the control made from a mixture of stearic and palmitic acids.

Table 1

Composition of Size	*kg/tonne (lb/ton) Addition Level*	*Natural Aged HST*	*Rate of Billowing**
Oleic Acid	0.75 (1.5)	122	1.6
"	1.1 (2.2)	212	15.1
"	1.5 (3.0)	265	29.4
"	2.0 (4.0)	331	55.5
Oleic Acid (Pamolyn 380)	1.1 (2.2)	62	1.6
Isostearic	1.1 (2.2)	176	1.5
Control	0.75 (1.5)	162	23.8
"	1.1 (2.2)	320	55.0

*Inches of billowing/sec. x 10,000.

Example 2

[0058] Additional sizing agents were tested for their effects on IBM 3800 paper runnability in a second set of experiments. The above Experimental Procedures were followed.

[0059] An AKD emulsion and an alkenyl succinic anhydride (ASA) emulsion were evaluated as controls. The ASA emulsion was prepared as described by Farley and Wasser in "The Sizing of Paper (Second Edition)," "Sizing with Alkenyl Succinic Anhydride" page 51, (1991). The performance parameters measured in these studies were natural aged sizing and runnability on the IBM 3800. A summary of the results of these evaluations is given in Table 2.

[0060] The materials tested gave a better balance of sizing and converting performance (less billowing at the same level of sizing) than either of the commercial ASA or AKD sizing agents used as controls. The best balance of sizing and handling performance was obtained with: a 2-oxetanone size prepared from Pamak-1 fatty acid (a mixture comprised primarily of oleic and linoleic acid) and a 2-oxetanone multimer prepared from a 2.5:1 mixture of oleic acid and

sebacic acid. Both sizing agents gave levels of sizing comparable to that obtained with the ASA and AKD controls. Both sizing agents gave paper with better runnability on the IBM 3800 than the paper sized with either the ASA or AKD standards.

Table 2

Composition of Size	*Addition Rate*	*Natural Aged HST*	*Rate of Billowing*
	kg/tonne (lb/ton)		
Oleic Linoleic	0.75 (1.5)	34	<1.7
"	1.1 (2.2)	203	<1.7
"	1.5 (3.0)	193	<4.6
"	2.0 (4.0)	250	17.5
Oleic/ Sebacic	0.75 (1.5)	53	<10.4
"	1.1(2.2)	178	<1.7
"	1.5 (3.0)	270	<3.4
"	2.0 (4.0)	315	16.6
Control (AKD)	0.75 (1.5)	162	166
"	1.1 (2.2)	320	48
Control (ASA)	0.75 (1.5)	127	52
"	1.1 (2.2)	236	83
"	1.5 (3.0)	286	166

Example 3

[0061] Two 2-oxetanone multimers prepared from mixtures of azelaic acid and oleic acid, and mixtures of azelaic acid and oleic/linoleic fatty acid, were tested. Paper for testing was prepared on the pilot paper machine using the conditions described in the Experimental Procedures. A standard paper sized with a commercial AKD size dispersion was evaluated as a control. A summary of the results of these evaluations is given in Table 3.

[0062] Both types of 2-oxetanone multimer gave levels of HST sizing similar to those obtained with the standard AKD control. Both multimer sizes gave lower levels of billowing on the IBM 3800 than the control.

Table 3

Composition of Size	*Addition Level kg/tonne (lb/ton)*	*Natural Aged HST*	*Rate of Billowing*
Oleic/ Azeleic 2.5:1	1.1 (2.2)	186	<1.2
"	1.5 (3)	301	<2.2
"	2.0 (4)	347	<2.3
Oleic/ Linoleic: Azeleic 2.5:1	1.1 (2.2)	160	<2.4
"	1.5 (3)	254	<2.4
"	2 (4)	287	<2.4
Control	1.1 (2.2)	267	10
"	1.5 (3)	359	23

EXAMPLE 4

[0063] A series of Pamak-1 fatty acid:azelaic acid 2-oxetanone multimers with fatty acid to dicarboxylic acid ratios ranging from 1.5:1 to 3.5:1 were evaluated in a fourth set of experiments. Paper for testing was again prepared on the pilot paper machine at Western Michigan University using the conditions described in Example 1. The performance parameters measured in these studies were: natural aged sizing efficiency (acid ink) and runnability on the IBM 3800.

Standard AKD and ASA sized paper were evaluated as controls. A summary of the results of these evaluations is given in Table 4.

[0064] All of the Pamak-1:azelaic acid 2-oxetanone multimers gave a better balance of sizing and IBM 3800 runnability than either of the commercial controls.

Table 4

Composition of Size	*Addition Level kg/tonne lb/ton*	*Natural Aged HST*	*Rate of Billowing*
1.5:1	1.3 (2.5)	209	<5
"	2.3 (4.5)	339	<5
2.5:1	1.0 (2.0)	214	<5
"	1.8 (3.5)	312	<5
"	2.0 (4.0)	303	<5
3.5:1	1.3 (2.5)	312	<5
"	2.0 (4.0)	303	<5
Control (AKD)	0.75 (1.5)	255	<5
"	1.5 (3.0)	359	15
Control (ASA)	1.5 (3.0)	253	23

EXAMPLE 5

[0065] An evaluation of a 2-oxetanone size made from oleic acid, with a comparison to a AKD commercial size made from a mixture of palmitic and stearic acids, was carried out on a high speed commercial fine paper machine (15.2 m/sec (3000 f.p.m), 18.2 metric tonnes (20 tons) of paper produced per hour, 56.4 g/m^2 15lb/1300 ft^2). A typical forms bond paper making stock similar to that used in Example 1 was used. Addition levels of the two sizing agents were adjusted to give comparable levels of HST sizing (20-30 seconds, 85% reflectance, Hercules Test Ink #2). No deposits were observed on the paper machine.

[0066] The paper produced under these conditions was then evaluated on a high speed Hamilton continuous forms press. The Hamilton press converts paper to a standard perforated continuous form. Press speed was used as a measure of performance. Two samples of the AKD control were tested before and after the evaluation of the paper sized with the oleic acid based size. The results are shown in Table 5. The paper sized with the oleic acid size clearly converted at a significantly higher press speed than the paper sized with the AKD control.

Table 5

Run #	***Sizing Agent***	*m/sec*	***Hamilton Press Speed***
1	AKD CONTROL	8.84	(1740 f.p.m.)
2	AKD CONTROL	8.84	(1740 f.p.m.)
3	OLEIC ACID 2-OXETANONE	9.14	(1800 f.p.m.)
4	OLEIC ACID 2-OXETANONE	9.02	(1775 f.p.m.)
5	AKD CONTROL	8.79	(1730 f.p.m.)
6	AKD CONTROL	8.76	(1725 f.p.m.)

EXAMPLE 6

[0067] An evaluation of oleic acid 2-oxetanone size, with a comparison with an AKD commercial standard size prepared from a mixture of palmitic and stearic acid, was carried out on a commercial paper machine producing a xerographic grade of paper (15.75 m/sec.) 3100 f.p.m.), 68.4 g/m^2 (42lb/3000 ft^2)). As in Example 5, addition levels of each sizing agent were adjusted to give comparable levels of HST sizing after natural aging (100-200 seconds of HST sizing, 80% reflectance, Hercules Test Ink #2). No deposits were observed on the paper machine. The paper produced with oleic acid 2-oxetanone size ran without any jams or double feeds on a high speed IBM 3825 sheet fed copier (no double feeds in 14,250 sheets). Paper prepared with the AKD controls had a much higher rate of double feeds on the IBM

3825 (14 double feeds in 14,250 sheets).

EXAMPLE 7

[0068] A 2-oxetanone size was prepared from oleic acid by known methods. A sizing emulsion was then prepared from the oleic acid-based size by known methods. Copy paper sized with the oleic acid-based sizing emulsion was made on a commercial fine paper machine (15.75 m/sec (3100 f.p.m), 36.4 metric tonnes (40 tons) of paper produced per hour, 75.2 g/m^2 (20lb/1300 ft^2), 10% precipitated calcium carbonate, 0.5 kg (1 lb) of sodium chloride/ton of paper added at the size press). Copy paper sized with a standard AKD (prepared from a mixture of palmitic acid and stearic acid) sizing emulsion was also made as a control. The addition level of each sizing agent was adjusted to give 50-100 seconds of HST sizing (0.7 kg 1.4 lb) of standard commercial AKD, 0.95 - 1.05 kg (1.9-2.1 lb) of oleic acid size per ton of paper, 80% reflectance, Hercules Test Ink #2).

[0069] The copy paper sized with oleic acid size ran without any jams or double feeds on a high speed IBM 3825 sheet fed copier (no double feeds in 99,000 sheets). The paper sized with the AKD control had a much high rate of double feeds on the IBM 3825 (14 double feeds in 27,000 sheets).

EXAMPLE 8

[0070] Two samples of 2-oxetanone-based sizing agents were prepared from oleic acid and Pamak-1 fatty acid (a mixture consisting primarily of linoleic and oleic acid) by known methods. Sizing emulsions were prepared from both sizes. Forms bond paper samples sized respectively with the Pamak-1 fatty acid-based size and -the oleic acid-based size were made on a commercial fine paper machine (approximately 15.2 m/sec (3000 f.p.m.), 60 g/m^2 (16lb/1300 ft^2), 2.5 kg/tonne (5lb/ton) alum, 5 kg/tonne (10lb/ton) quaternary amine substituted starch). Forms bond paper sized with a commercial AKD (prepared from a mixture of palmitic acid and stearic acid) sizing emulsion was also made as a control. The addition level of each sizing agent (See Table 6) was adjusted to give comparable levels of HST sizing at the reel (70% reflectance, Hercules Test Ink #2).

[0071] The paper produced under these conditions was converted on a high speed Hamilton continuous forms press. The Hamilton press converts paper to a standard perforated continuous form. Press speed was used as a measure of paper performance. The results are listed in the following Table 6. Each press speed is an average of measurements made on six different rolls of paper. The paper sized with the oleic acid-based size and the paper sized with the Pamak-1 fatty acid-based size converted at a significantly higher press speed than the paper sized with the AKD control.

Table 6

Run #	*Sizing Agent*	*Add'n Level kg/ tonne*	*HST Sizing (seconds)*	*m/sec Hamilton Press Speed*
1	AKD Control	1.0 (2.0lb/Ton)	208	9.43 (1857 f.p.m.)
2	Oleic Acid-based Size	1.3 (2.5lb/Ton)	183	9.94 (1957 f.p.m.)
3	PAMAK-1 Fatty Acid-based Size	1.3 (2.5lb/Ton)	185	10.1 (1985 f.p.m.)

EXAMPLE 9

[0072] A 2-oxetanone-based sizing agent was prepared from oleic acid by known methods. A sizing emulsion was then prepared from the oleic acid-based sizing agent by known methods. Envelope paper sized with the oleic acid-based sizing emulsion and containing 16% precipitated calcium carbonate was made on a commercial fine paper machine in two basis weights, 75.2 g/m^2 and 90.2 g/m^2 (20lb and 24lb per 1300 ft^2). Envelope paper sized with a standard commercial AKD (prepared from a mixture of palmitic acid and stearic acid) and a commercial surface sizing agent (0.25 kg/tonne 0.5lb/ton) Graphsize A) sizing emulsion was also made as a control. The addition level of each internal sizing agent was adjusted to give comparable levels of HST sizing at the reel (100-150 seconds, 80% reflectance, Hercules Test Ink #2).

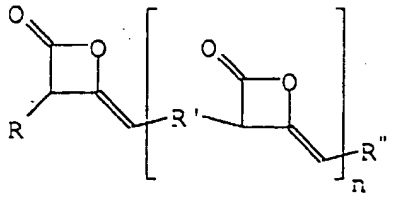
[0073] The paper sized with each of the two sizing agents was converted to envelopes on a Winkler & Dunnebier CH envelope folder. The 75.2 g/m^2 (20lb) paper was converted to "Church" envelopes. The 90.2 kg/m^2 (24lb) paper was converted to standard #10 envelopes. Envelope production rate (envelopes per minute) was used as a measure of paper converting performance. The results are listed in the following Table 7. The paper sized with the oleic acid-based size converted at a significantly higher speed than the paper sized with the AKD control.

Table 7

Sizing Agent	kg/tonne Size Add'n Level	HST (sec.)	g/m²Basis Weight	Product	Envelopes per Minute
AKD Control	1.0 (2.0lb/Ton)	100-150	75.2 (20lb)	Church Envelope	850
Oleic Acid-based Size	1.5 (2.9lb/Ton)	100-150	75.2 (20lb)	Church Envelope	900-950
AKD Control	0.75 (1.5lb/Ton)	100-150	90.2 (24lb)	#10 Envelope	965
Oleic Acid-based Size	1.3 (2.5lb/Ton)	100-150	90.2 (24lb)	#10 Envelope	1000-1015

Claims

1. Use of alkaline fine paper sized with a 2-oxetanone sizing agent of formula (I) which is liquid at 25°C for high speed reprography or conversion into standard perforated continuous form paper, envelopes, adding machine paper or continuous forms bond paper;



(I)

wherein n is an integer of 0-6, R and R" are independently a straight or branched chain alkyl group having at least 6 carbon atoms or a straight or branched chain alkenyl group having at least 6 carbon atoms and R' is a straight chain alkyl group, provided that one or both of R and R" are alkenyl and/or branched alkyl.

2. Use according to Claim 1, wherein the 2-oxetanone sizing agent is liquid at 20°C.

3. Use according to Claim 1, wherein one or both R and R" is/are alkenyl.

4. Use according to any preceding Claim, wherein one or both R and R" is/are branched.

5. Use according to any preceding Claim, wherein R and R" have 10 to 22 carbon atoms.

6. Use according to any preceding Claim, wherein n is 0 (zero).

7. Use according to any one of Claims 1 to 5, wherein n is 1 or more.

8. Use according to Claim 7, wherein the compound of formula (I) is formed from at least one dicarboxylic acid selected from sebacic acid and azelaic acid.

9. Use according to any preceding Claim, wherein at least 25% of the sizing agent comprises the 2-oxetanone sizing agent of formula (I).

10. Use according to Claim 9, wherein at least 50% of the sizing agent comprises the 2-oxetanone sizing agent of formula (I).

11. Use according to Claim 10, wherein at least 70% of the sizing agent comprises the 2-oxetanone sizing agent of formula (I).

12. Use according to any preceding Claim, wherein the alkaline fine paper contains a water soluble inorganic salt of an alkali metal.

13. Use according to Claim 12, wherein the salt is NaCl.

14. Use according to any preceding Claim, wherein the 2-oxetanone sizing agent is made from a fatty acid selected from oleic acid, linoleic acid, dodecenoic acid, myristoleic acid, palmitoleic acid, linolelaidic acid, linolenic acid, gadoleic acid, arachidonic acid, erucic acid, brassidic acid and clupanodonic acid, or a mixture of any thereof.

15. Use according to Claim 14, wherein the 2-oxetanone sizing agent is formed from a mixture of fatty acids containing at least 25 wt.% oleic acid.

16. Use according to Claim 14 or 15, wherein the 2-oxetanone sizing agent is formed from a mixture of fatty acids containing at least 25 wt.% linoleic acid.

17. Use according to Claim 16, wherein the 2-oxetanone sizing agent is formed from a mixture of fatty acids containing at least 35 wt.% linoleic acid.

18. Use according to Claim 14, wherein the 2-oxetanone sizing agent is formed from a mixture comprising 35-65 wt. % of linoleic acid and 65-35 wt.% of oleic acid.

19. Use according to Claim 1, wherein the 2-oxetanone sizing agent is formed from isostearic acid.

20. Use according to any preceding Claim, wherein the alkaline fine paper contains at least 0.25 kg/metric ton (0.5 pounds/ton) of sizing agent.

21. Use according to Claim 20, wherein the alkaline fine paper contains 1.1 to 4.0 kg/metric ton (2.2-8 pounds/ton) of sizing agent.

22. Use according to any preceding Claim, wherein the alkaline fine paper is internally sized with the 2-oxetanone sizing agent.

23. Use of paper in high speed conversion or reprography according to any preceding Claim, for the prevention of significant machine feed problems during said converting or reprographic operations.

24. Use according to any preceding Claim, wherein the use is in high speed reprography and the reprography is carried out by a high speed photocopier.

25. Use according to Claim 24, wherein the reprography comprises processing the paper on a photocopy machine at a rate of at least 58 sheets per minute.

26. Use according to any of Claims 1 to 23, wherein the use is in high speed reprography and the reprography is carried out by a continuous-forms laser printer.

27. Use according to Claim 26, wherein the reprography comprises running the paper on a high speed continuous forms laser printer with a rate of billowing in inches of increase multiplied by 10,000 of 5 or less (equivalent to a rate of billowing in cm of increase multiplied by 10,000 of 12.7 or less) after ten minutes (600 seconds) of running time.

28. Use according to any of Claims 1 to 23, wherein the alkaline fine paper is cut alkaline fine paper and the use is in high speed reprography and the reprography is carried out on a high speed laser printer or copier.

29. Use according to Claim 28, wherein the reprography comprises running the paper in the form of reprographic cut paper on a high speed laser printer or copier with causing misfeeds or jams at a rate of 5 or less in 10,000.

30. Use according to any of Claims 1 to 23, wherein the use is in high speed conversion and the conversion is into standard perforated continuous form paper.

31. Use according to Claim 30, wherein the conversion comprises converting paper to a standard perforated continuous form on a continuous forms press at a press speed of at least about 541m (1775 feet) per minute.

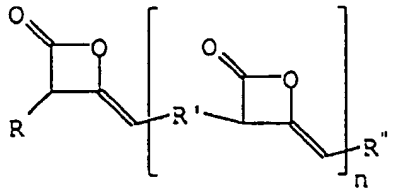
32. Use according to any of Claims 1 to 23, wherein the use is in high speed conversion and the conversion is into envelopes.

33. Use according to Claim 32, wherein the conversion comprises converting the paper into at least 900 envelopes per minute.

34. Use according to any of Claims 1 to 23, wherein the use is in high speed conversion and the conversion is into continuous forms bond paper.

Patentansprüche

1. Verwendung von alkalischem Feinpapier, das mit einem 2-Oxetanon-Leimungsmittel der Formel (I) geleimt ist, welches bei 25°C flüssig ist, zur Hochgeschwindigkeitsreprographie oder -konvertierung zu perforiertem Standard-Endlosvordruckpapier, Umschlägen, Addiermaschinenpapier oder EndlosSchreibmaschinenpapier;



(I)

worin n eine ganze Zahl aus 0 bis 6 ist, R und R" unabhängig eine gerad- oder verzweigtkettige Alkyl-Gruppe mit wenigstens 6 Kohlenstoffatomen oder eine gerad- oder verzweigtkettige Alkenyl-Gruppe mit wenigstens 6 Kohlenstoffatomen sind und R' eine geradkettige Alkyl-Gruppe ist, mit der Maßgabe, daß eines oder beide aus R und R" Alkenyl und/oder verzweigtes Alkyl sind.

2. Verwendung gemäß Anspruch 1, worin das 2-Oxetanon-Leimungsmittel bei 20°C flüssig ist.

3. Verwendung gemäß Anspruch 1, worin eines oder beide R und R" Alkenyl ist/sind.

4. Verwendung gemäß einem der vorhergehenden Ansprüche, worin eines oder beide R und R" verzweigt ist/sind.

5. Verwendung gemäß einem der vorhergehenden Ansprüche, worin R und R" 10 bis 22 Kohlenstoffatome aufweisen.

6. Verwendung gemäß einem der vorhergehenden Ansprüche, worin n 0 (Null) ist.

7. Verwendung gemäß einem der Ansprüche 1 bis 5, worin n 1 oder mehr ist.

8. Verwendung gemäß Anspruch 7, worin die Verbindung der Formel (I) aus wenigstens einer Dicarbonsäure gebildet wird, ausgewählt aus Sebacinsäure und Azelainsäure.

9. Verwendung gemäß einem der vorhergehenden Ansprüche, worin wenigstens 25 % des Leimungsmittels das 2-Oxetanon-Leimungsmittel der Formel (I) umfassen.

10. Verwendung gemäß Anspruch 9, worin wenigstens 50 % des Leimungsmittels das 2-Oxetanon-Leimungsmittel der Formel (I) umfassen.

11. Verwendung gemäß Anspruch 10, worin wenigstens 70 % des Leimungsmittels das 2-Oxetanon-Leimungsmittel der Formel (I) umfassen.

12. Verwendung gemäß einem der vorhergehenden Ansprüche, worin das alkalische Feinpapier ein wasserlösliches anorganisches Salz eines Alkalimetalls enthält.

13. Verwendung gemäß Anspruch 12, worin das Salz NaCl ist.

14. Verwendung gemäß einem der vorhergehenden Ansprüche, worin das 2-Oxetanon-Leimungsmittel hergestellt wird aus einer Fettsäure, ausgewählt aus Oleinsäure, Linolsäure, Dodecensäure, Myristoleinsäure, Palmitoleinsäure, Linolelaidinsäure, Linolensäure, Gadoleinsäure, Arachidonsäure, Erucasäure, Brassidinsäure und Clupanodonsäure, oder einer Mischung daraus.

15. Verwendung gemäß Anspruch 14, worin das 2-Oxetanon-Leimungsmittel aus einer Mischung aus Fettsäuren gebildet wird, die wenigstens 25 Gew.-% Oleinsäure enthält.

16. Verwendung gemäß Anspruch 14 oder 15, worin das 2-Oxetanon-Leimungsmittel aus einer Mischung aus Fettsäuren gebildet wird, die wenigstens 25 Gew.-% Linolsäure enthält.

17. Verwendung gemäß Anspruch 16, worin das 2-Oxetanon-Leimungsmittel aus einer Mischung aus Fettsäuren gebildet wird, die wenigstens 35 Gew.-% Linolsäure enthält.

18. Verwendung gemäß Anspruch 14, worin das 2-Oxetanon-Leimungsmittel aus einer Mischung gebildet wird, die 35 bis 65 Gew.-% Linolsäure und 65 bis 35 Gew.-% Oleinsäure umfaßt.

19. Verwendung gemäß Anspruch 1, worin das 2-Oxetanon-Leimungsmittel aus Isostearinsäure gebildet wird.

20. Verwendung gemäß einem der vorhergehenden Ansprüche, worin das alkalische Feinpapier wenigstens 0,25 kg/t (0,5 pounds/ton) Leimungsmittel enthält.

21. Verwendung gemäß Anspruch 20, worin das alkalische Feinpapier 1,1 bis 4,0 kg/t (2,2 bis 8 pounds/ton) Leimungsmittel enthält.

22. Verwendung gemäß einem der vorhergehenden Ansprüche, worin das alkalische Feinpapier mit dem 2-Oxetanon-Leimungsmittel massegeleimt ist.

23. Verwendung von Papier in der Hochgeschwindigkeitskonvertierung oder -reprographie gemäß einem der vorhergehenden Ansprüche zur Verhinderung wesentlicher Maschinenzufuhrprobleme während der Konvertierungs- oder Reprographie-Arbeitsvorgänge.

24. Verwendung gemäß einem der vorhergehenden Ansprüche, worin die Verwendung in der Hochgeschwindigkeitsreprographie liegt und die Reprographie mit einem Hochgeschwindigkeitsphotokopierer durchgeführt wird.

25. Verwendung gemäß Anspruch 24, worin die Reprographie die Verarbeitung des Papiers auf einer Photokopiermaschine mit einer Geschwindigkeit von wenigstens 58 Blättern pro Minute umfaßt.

26. Verwendung gemäß einem der Ansprüche 1 bis 23, worin die Verwendung in der Hochgeschwindigkeitsreprographie liegt und die Reprographie mit einem Endlosvordruck-Laserdrucker durchgeführt wird.

27. Verwendung gemäß Anspruch 26, worin die Reprographie die Verarbeitung des Papiers auf einem Hochgeschwindigkeits-Endlosvordruck-Laserdrucker mit einer Rate des Wellenwerfens in Zollzunahme multipliziert mit 10 000 von 5 oder weniger (entsprechend einer Rate des Wellenwerfens in cm-Zunahme multipliziert mit 10 000 von 12,7 oder weniger) nach 10 min (600 s) Betriebszeit umfaßt.

28. Verwendung gemäß einem der Ansprüche 1 bis 23, worin das alkalische Feinpapier geschnittenes alkalisches Feinpapier ist und die Verwendung in der Hochgeschwindigkeitsreprographie liegt und die Reprographie auf einem Hochgeschwindigkeits-Laserdrucker oder -Kopierer durchgeführt wird.

29. Verwendung gemäß Anspruch 28, worin die Reprographie die Verarbeitung des Papiers in Form von Reprographie-Schnittpapier auf einem Hochgeschwindigkeits-Laserdrucker oder -Kopierer umfaßt, ohne daß Fehlzuführungen oder Staus mit einer Rate von 5 oder weniger in 10 000 verursacht werden.

30. Verwendung gemäß einem der Ansprüche 1 bis 23, worin die Verwendung in der Hochgeschwindigkeitskonvertierung liegt und die Konvertierung diejenige zu perforiertem Standard-Endlosvordruckpapier ist.

31. Verwendung gemäß Anspruch 30, worin die Konvertierung das Konvertieren von Papier zu einem perforiertem Standard-Endlosformular auf einer Endlos-Formdruckmaschine mit einer Druckmaschinengeschwindigkeit von wenigstens ca. 541 m (1775 fee) pro Minute umfaßt.

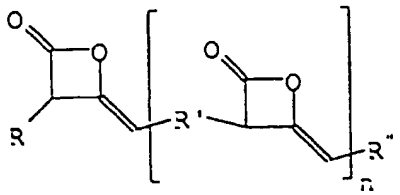
32. Verwendung gemäß einem der Ansprüche 1 bis 23, worin die Verwendung in der Hochgeschwindigkeitskonvertierung liegt und die Konvertierung diejenige zu Umschlägen ist.

33. Verwendung gemäß Anspruch 32, worin die Konvertierung das Konvertieren des Papiers zu wenigstens 900 Umschlägen pro Minute umfaßt.

34. Verwendung gemäß einem der Ansprüche 1 bis 23, worin die Verwendung in der Hochgeschwindigkeitskonvertierung liegt und die Konvertierung diejenige zu Endlosschreibmaschinenpapier ist.

Revendications

1. Utilisation d'un papier fin alcalin collé avec un agent de collage à base de 2-oxétanone, répondant à la formule (I), qui est liquide à 25°C pour la reprographie ou conversion à grande vitesse en papier pour formulaires continus perforés classiques, enveloppes, papier pour machine à calculer ou papier bond pour formulaires continus ;



(I)

formule dans laquelle n représente un nombre entier de 0 à 6, R et R" représentent indépendamment un groupe alkyle à chaîne droite ou ramifié ayant au moins 6 atomes de carbone ou un groupe alcényle à chaîne droite ou ramifiée ayant au moins 6 atomes de carbone et R' représente un groupe alkyle à chaîne droite, sous réserve que l'un des ou les deux groupes R et R" représente(nt) un ou des groupes alcényle et/ou groupes alkyle ramifiés.

2. Utilisation suivant la revendication 1, dans laquelle l'agent de collage à base de 2-oxétanone est liquide à 20°C.

3. Utilisation suivant la revendication 1, dans laquelle l'un des ou les deux groupes R et R" représente(nt) un ou des groupes alcényle.

4. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle l'un des ou les deux groupes R et R" est ou sont ramifiés.

5. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle R et R" ont 10 à 22 atomes de carbone.

6. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle n est égal à 0 (zéro).

7. Utilisation suivant l'une quelconque des revendications 1 à 5, dans laquelle n est égal ou supérieur à 1.

8. Utilisation suivant la revendication 7, dans laquelle le composé de formule (I) est formé à partir d'au moins un acide dicarboxylique choisi entre l'acide sébacique et l'acide azélaïque.

9. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle une quantité d'au moins 25 % de l'agent de collage est constituée de l'agent de collage à base de 2-oxétanone de formule (I).

10. Utilisation suivant la revendication 9, dans laquelle une quantité d'au moins 50 % de l'agent de collage est constituée de l'agent de collage de 2-oxétanone de formule (I).

11. Utilisation suivant la revendication 10, dans laquelle une quantité d'au moins 70 % de l'agent de collage est constituée de l'agent de collage à base de 2-oxétanone de formule (I).

12. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle le papier fin alcalin contient un sel inorganique hydrosoluble d'un métal alcalin.

13. Utilisation suivant la revendication 12, dans laquelle le sel consiste en NaCl.

14. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle l'agent de collage à base de 2-oxétanone est préparé à partir d'un acide gras choisi entre l'acide oléique, l'acide linoléique, l'acide dodécénoïque, l'acide myristoléique, l'acide palmitoléique, l'acide linolélaïdique, l'acide linolénique, l'acide gadoléique, l'acide arachidonique, l'acide érucique, l'acide brassidique, et l'acide clupanodonique, ou un mélange de n'importe lesquels de ces acides.

15. Utilisation suivant la revendication 14, dans laquelle l'agent de collage à base de 2-oxétanone est formé à partir d'un mélange d'acides gras contenant au moins 25 % en poids d'acide oléique.

16. Utilisation suivant la revendication 14 ou 15, dans laquelle l'agent de collage à base de 2-oxétanone est formé à partir d'un mélange d'acides gras contenant au moins 25 % en poids d'acide linoléique.

17. Utilisation suivant la revendication 16, dans laquelle l'agent de collage à base de 2-oxétanone est formé à partir d'un mélange d'acides gras contenant au moins 35 % en poids d'acide linoléique.

18. Utilisation suivant la revendication 14, dans laquelle l'agent de collage à base de 2-oxétanone est formé à partir d'un mélange comprenant 35 à 65 % en poids d'acide linoléique et 65 à 35 % en poids d'acide oléique.

19. Utilisation suivant la revendication 1, dans laquelle l'agent de collage à base de 2-oxétanone est formé à partir d'acide isostéarique.

20. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle le papier fin alcalin contient au moins 0,25 kg/tonne métrique (0,5 lb/tonne) d'agent de collage.

21. Utilisation suivant la revendication 20, dans laquelle le papier fin alcalin contient 1,1 à 4,0 kg/tonne métrique (2,2 à 8 lb/tonne) d'agent de collage.

22. Utilisation suivant l'une quelconque des revendications précédentes, dans laquelle le papier fin alcalin est soumis à un collage interne avec l'agent de collage à base de 2-oxétanone.

23. Utilisation du papier dans la conversion ou reprographie à grande vitesse suivant l'une quelconque des revendications précédentes, pour éviter des problèmes notables d'alimentation de la machine au cours desdites opérations de conversion ou de reprographie.

24. Utilisation suivant l'une quelconque des revendications précédentes, qui est destinée à la reprographie à grande vitesse, reprographie qui est effectuée par un photocopieur à grande vitesse.

25. Utilisation suivant la revendication 24, dans laquelle la reprographie comprend le traitement du papier sur une photocopieuse à une vitesse d'au moins 58 feuilles par minute.

26. Utilisation suivant l'une quelconque des revendications 1 à 23, qui est destinée à une reprographie à grande vitesse, reprographie qui est effectuée par une imprimante à faisceau laser pour formulaires continus.

27. Utilisation suivant la revendication 26, dans laquelle la reprographie comprend l'utilisation du papier sur une imprimante à faisceau laser pour formulaires continus à grande vitesse, avec une vitesse d'ondulation en inches d'augmentation multipliée par 10 000 égale ou inférieure à 5 (équivalente à une vitesse d'ondulation en centimètres d'augmentation multipliée par 10 000 égale ou inférieure à 12,7) après un temps de fonctionnement de 10 minutes

(600 secondes).

28. Utilisation suivant l'une quelconque des revendications 1 à 23, dans laquelle le papier fin alcalin consiste en papier fin alcalin coupé et l'utilisation est destinée à la reprographie à grande vitesse, reprographie qui est effectuée sur une imprimante ou un copieur à faisceau laser à grande vitesse.

29. Utilisation suivant la revendication 28, dans laquelle la reprographie comprend l'utilisation du papier sous forme de papier coupé reprographique sur une imprimante ou un copieur à faisceau laser à grande vitesse en provoquant des défauts d'introduction ou blocages à un taux égal ou inférieur à 5 pour 10 000.

30. Utilisation suivant l'une quelconque des revendications 1 à 23, qui est destinée à une conversion à grande vitesse, conversion qui consiste en la conversion en papier pour formulaires continus perforés classiques.

31. Utilisation suivant la revendication 30, dans laquelle la conversion comprend la conversion du papier en un formulaire continu perforé classique sur une presse à formulaires continus à une vitesse de presse d'au moins environ 541 m (1775 ft) par minute.

32. Utilisation suivant l'une quelconque des revendications 1 à 23, qui est destinée à une conversion à grande vitesse, qui consiste en une conversion en enveloppes.

33. Utilisation suivant la revendication 32, dans laquelle la conversion comprend la transformation du papier en au moins 900 enveloppes par minute.

34. Utilisation suivant l'une quelconque des revendications 1 à 23, qui est destinée à une conversion à grande vitesse, consistant en la conversion en papier bond pour formulaires continus.